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(56) Documents Cited
EP 0657762 A1 EP 0588504 A1 EP 0534140 A1
EP 0495273 A1 US 5627926 A US 5600455 A
US 5506929 A US 5408388 A
Pat. Abs. Jap. & J09304605 (Sekisui, 1997) Pat. Abs. Jap. & J07151924, J07151921 (Meitaku, 1995) Pat. Abs. Jap. & J06308485 (Hitachi, 1994)

(58) Field of Search
UK CL (Edition P) G5C CHX
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Online: WPI, JAPIO Databases.

(54) Abstract Title
Enhanced back light structure

(57) An enhanced back light structure suitable for use in illuminating an LCD panel comprises a light guiding plate 21 and a plurality of LEDs 23 arranged below or along the side of the plate 21. The light guiding plate has upon its upper surface an array of parallel grooves, of triangular cross section, which extend in one dimension (see fig.2 and fig. 3). Alternatively, two arrays of such grooves may be provided such that the grooves of one array extend in a direction perpendicular to that of the grooves of the other array. The first case results in the upper surface of said light guiding plate being covered with parallel prismatic ridges which, by refraction and reflection therefrom, direct and concentrate the light from the light sources 23 through the upper surface of the plate. The second case results in the upper surface of said light guiding plate being covered with parallel rows of prismatic pyramid structures 25 which direct and concentrate the light from the light sources 23 through the upper surface of the plate.

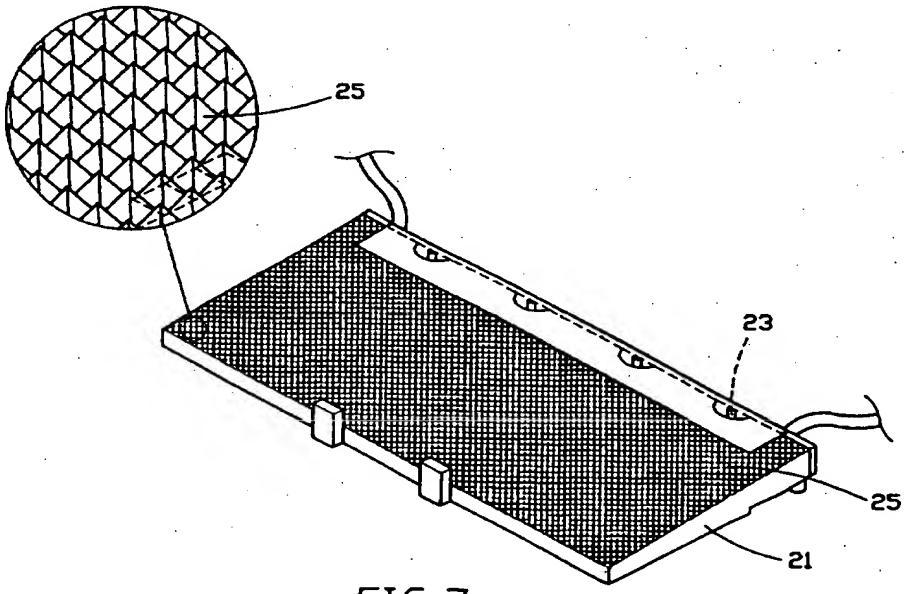

FIG. 7

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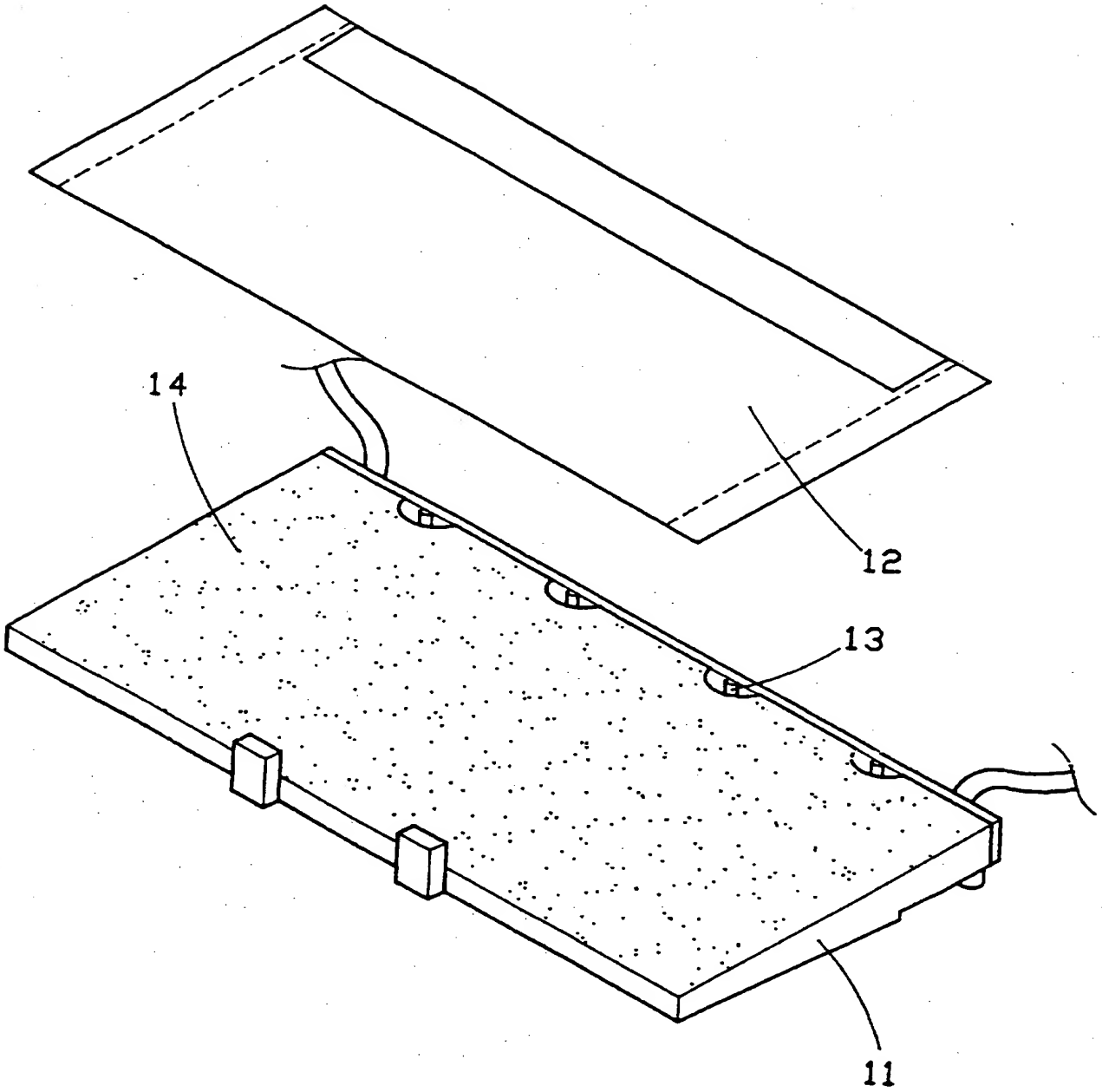

FIG. 1

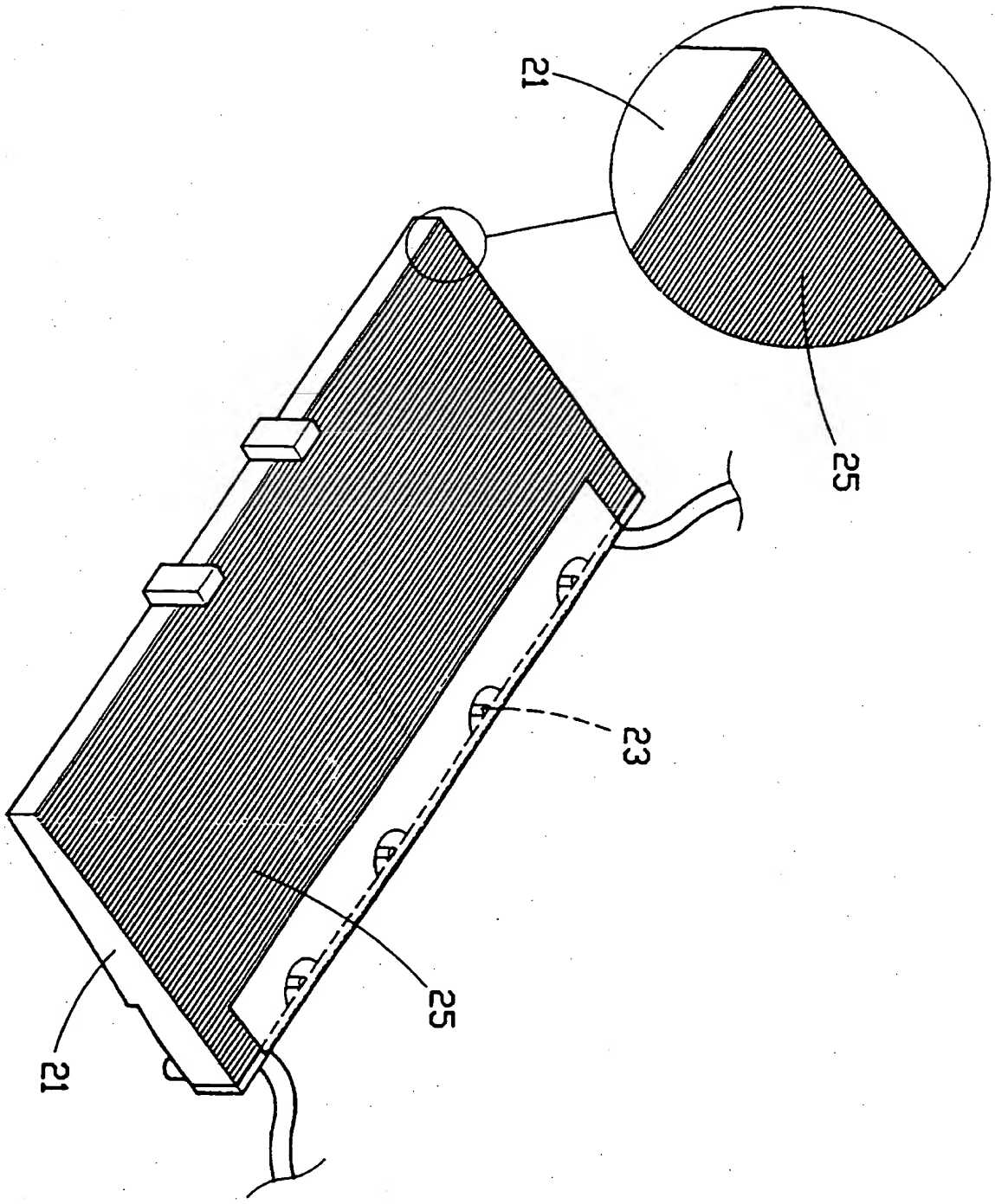

FIG. 2

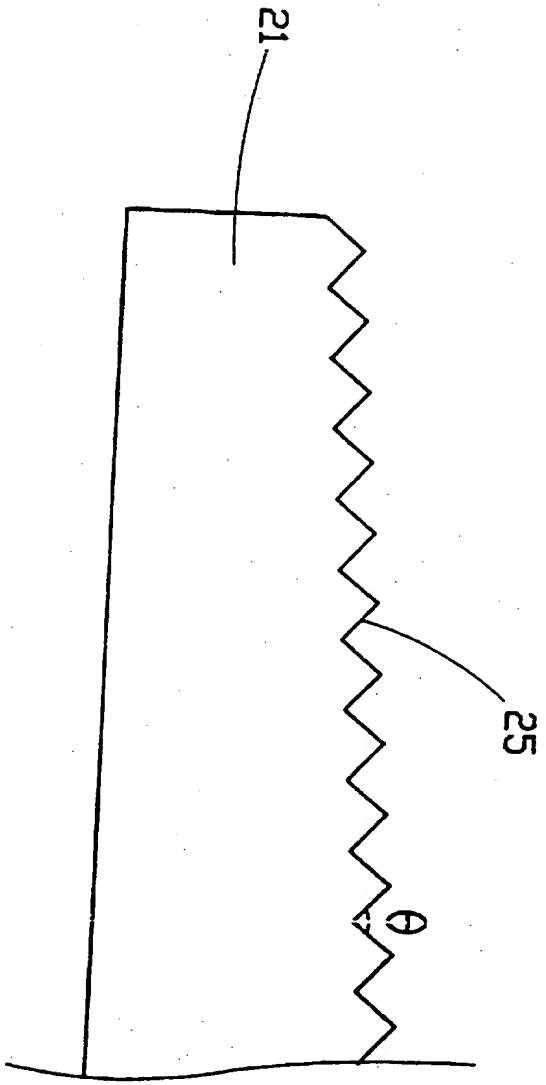

FIG. 3

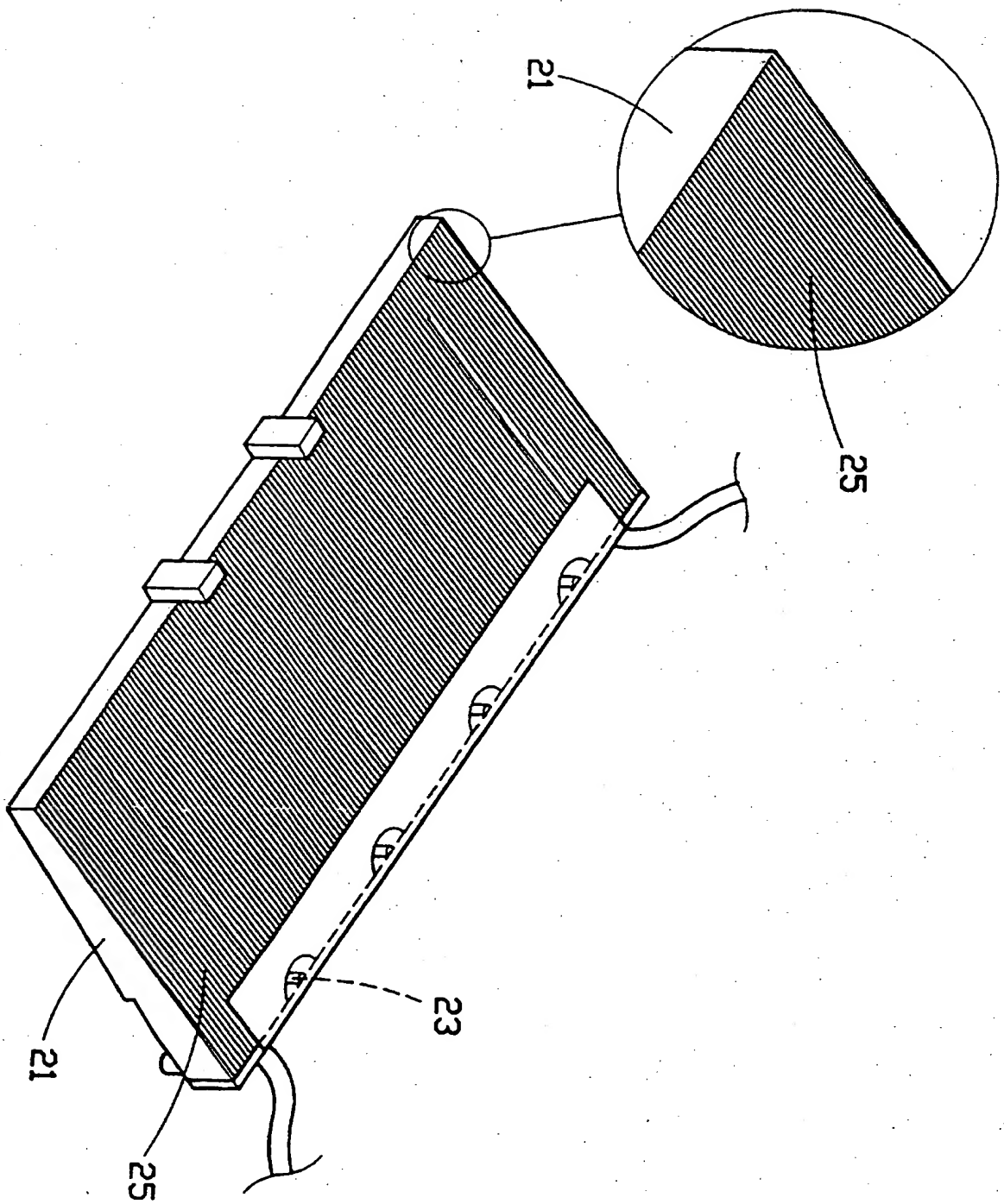

FIG. 4

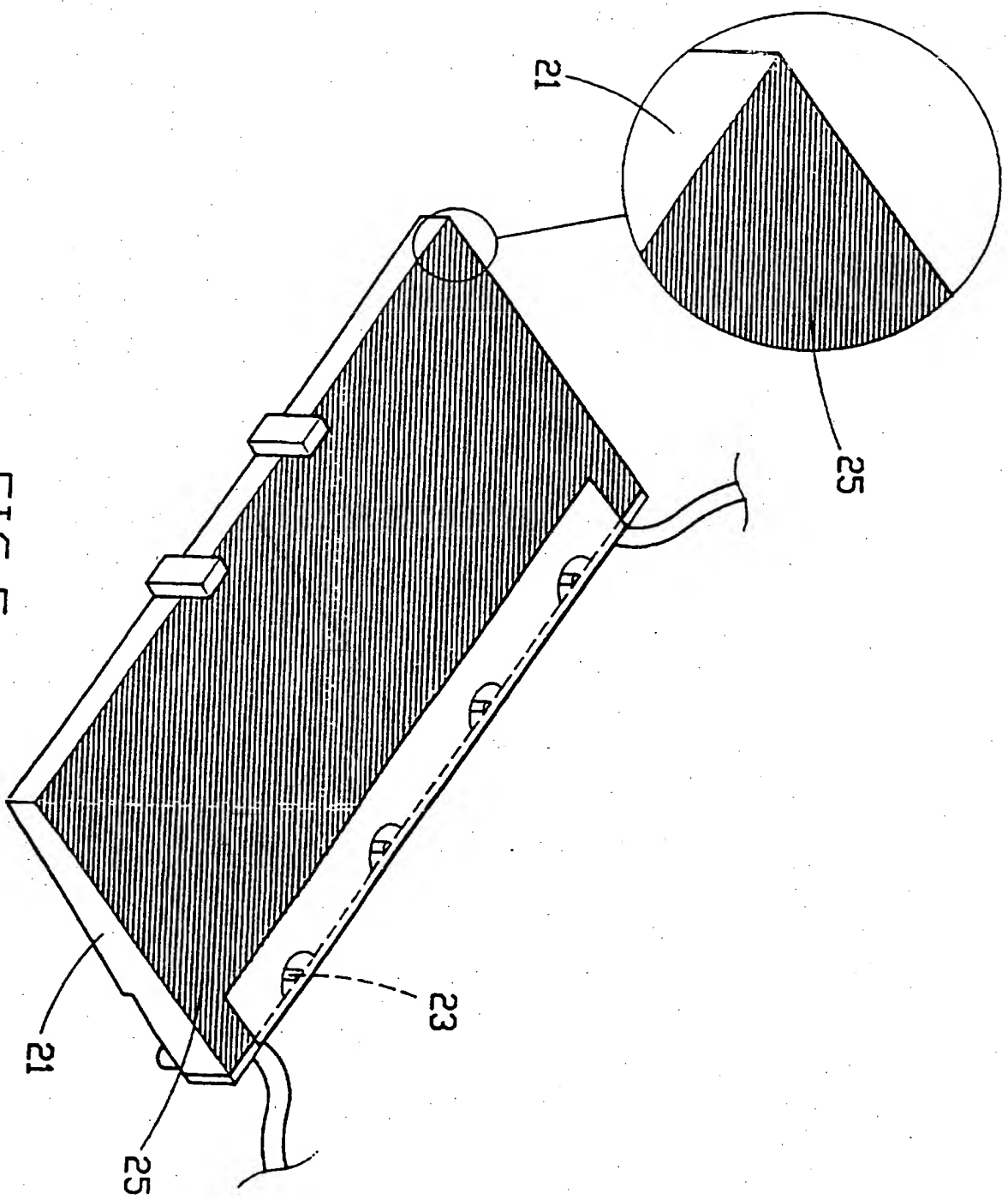

FIG.5

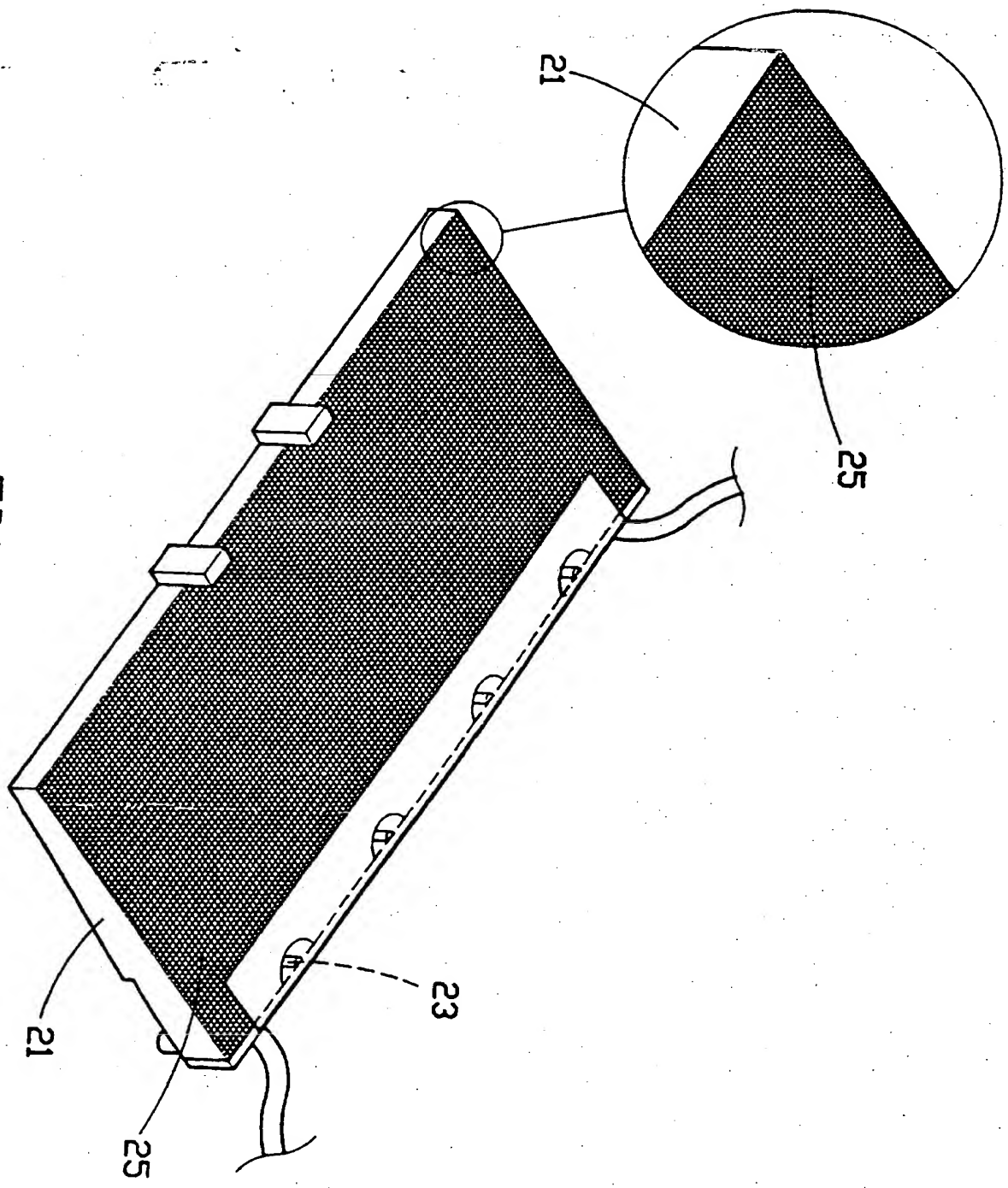

FIG.6

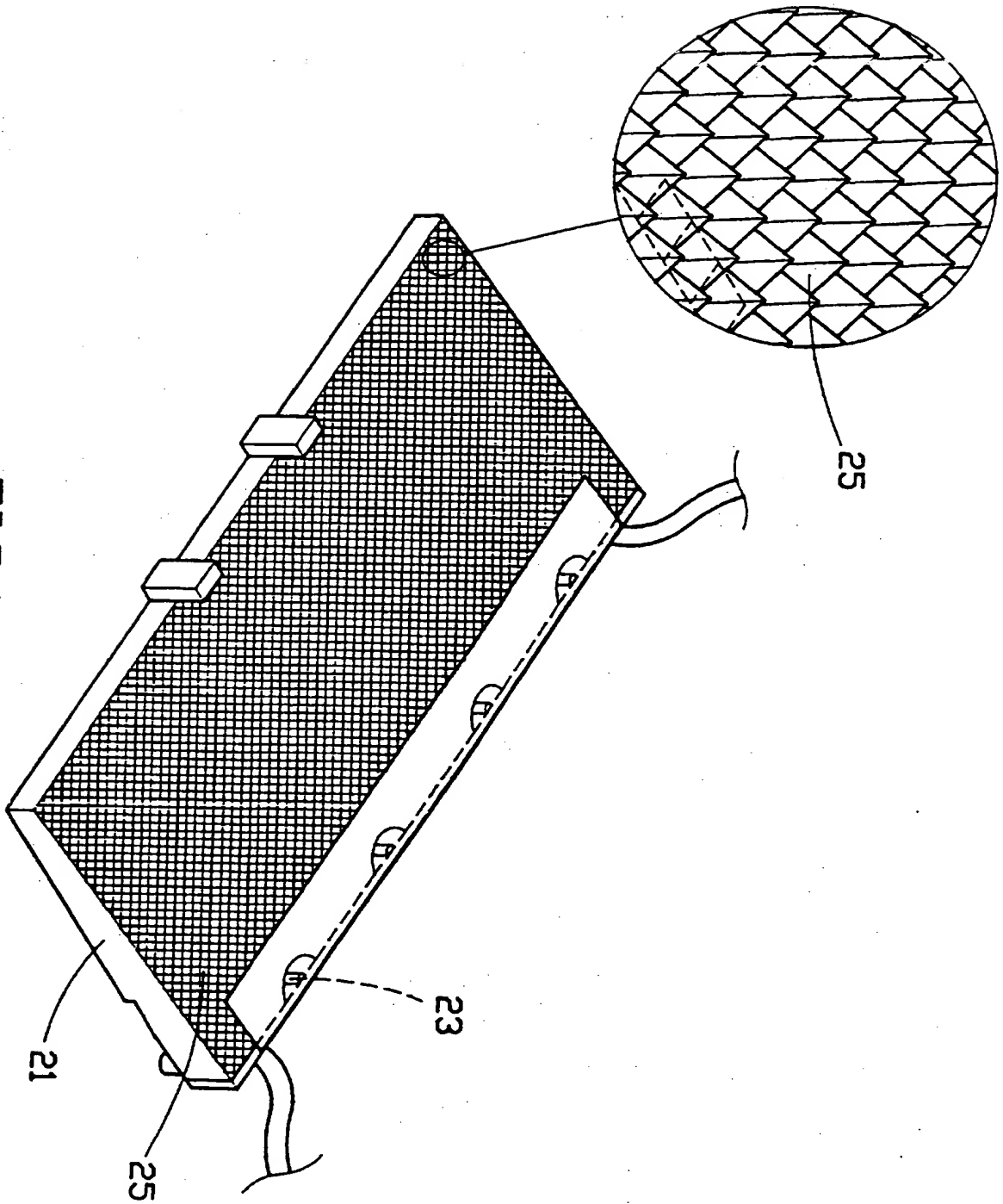

FIG. 7

Title of the utility: Enhanced back light structure

Field of the utility

The present utility relates to an enhanced back light structure, more particularly, to an enhanced back light structure which can increase above 50% luminance in comparison with the prior art.

Background of the utility

A back light device is employed to provide lighting for indicating means such as viewing-window or display means, and can provide clearer indicating effect in nightly application. The light-guiding plate in the viewing-window is generally subjected to a special process on its front or back surface to enhance its luminance.

The conventional diode-type back light device generally can not provide sufficient luminance such that the number and grade of diode should be enhanced to provide desired luminance. However, the cost and power consumption will increase.

For the conventional diode-type back light device, the front or back surface of its light-guiding plate is often carved or roughened to form a hazy surface such that the light will be scattered and emit from the light-guiding plate. However, the uniformity of light is hard to control and the luminance will decrease.

To enhance the luminance of light from the hazy-surfaced light-guiding plate, the conventional notebook computer is often provided with an opaque light-diffusion plate on the surface of the back light thereof. The opaque light-diffusion plate can shrink the light-emitting angle from the light-guiding plate such that the luminance is enhanced uniformly. However, the light-diffusion plate can only enhance a limited luminance and is expensive, for example, a NTD is required per square centimeter surface for a notebook computer.

Fig.1 shows the exploded view of a conventional back light structure. The conventional back light comprises a light-guiding plate 11, a light-diffusion plate 12 and a plurality of LEDs (light emitting diode) 13 wherein the light-guiding plate 11 is arranged upon a stage on a circuit board and the LEDs 13 are arranged on the circuit

board to provide light source.

The light-guiding plate 11 has formed a carving 14 by special process on the front or back surface thereof to form a hazy surface. The LEDs 13 are arranged beside or below the light-guiding plate 11 and the opaque light-diffusion plate 12 is attached on the top surface of the light-guiding plate 11 to form a back light structure.

It is an object of the present utility to solve the problem in the conventional diode back light in which the luminance is weakened and the uniformity can not be will controlled due to the employment of a haze surface on the light-guiding plate, and the cost is increased due to the employment of expensive light-diffusion plate.

It is another object of the present utility to provide a prismatic structure over the surface of the light-guiding plate such that the light propagating within the light-guiding plate can be guided to the front direction through the refraction or reflection by the prismatic structure. Moreover, the angle of the prismatic structure which determines the viewing angle of front surface correlates with the viewing angle of the LCD (liquid crystal display). The LCD generally has not large viewing angle, the prismatic structure can concentrate the emitting light to the extent of viewing angle, thus enhancing the front-side luminance.

It is still another object of the present utility to provide a back light structure which is thinner than that of prior art and can employ LED of lower grade and less number while the luminance is uniformly enhanced and easy to control, thus saving cost and power consumption.

The back light structure according to the present utility is characterized in that the surface of the light-guiding plate has been provided with a prismatic structure having one- or two-dimensional corrugation, and the lateral or bottom surface of the light-guiding plate has been provided with at least one LED, wherein the prismatic structure can be formed by mold injection.

The back light structure according to the present utility comprises a light-guiding plate, a plurality of LED arranged below or beside the light-guiding plate, and a

prismatic structure having one- or two-dimensional corrugation and located on the top surface of the light-guiding plate, such that the light traveling within the light-guiding plate can be directed, through refraction or reflection by the prismatic structure, to the front side.

Brief description of the drawings

In order to better understand the present utility, reference should be made to the following detailed description taken in junction with the accompanying drawings wherein:

Fig. 1 is the exploded view of the conventional back light;

Fig. 2 is the perspective view of the first embodiment of the enhanced back light structure according to the present utility;

Fig. 3 is the side view of the enhanced back light structure in Fig. 2;

Fig. 4 is the perspective view of the second embodiment of the enhanced back light structure according to the present utility;

Fig. 5 is the perspective view of the third embodiment of the enhanced back light structure according to the present utility;

Fig. 6 is the perspective view of the fourth embodiment of the enhanced back light structure according to the present utility; and

Fig. 7 is the perspective view of the fifth embodiment of the enhanced back light structure according to the present utility.

Detail description of the preferred embodiments

Referring now to Fig. 2, this figure shows the perspective view of the first embodiment of the enhanced back light structure according to the present utility. The enhanced back light structure according to the present utility comprises a light-guiding plate 21 arranged on a stage of a circuit board, a plurality of LED 23 arranged on the circuit board to serve as a light source, a prismatic structure 25 provided on the top surface of the light-guiding plate 21, wherein the LED 23 are placed below the light-guiding plate 21, thus forming a back light.

After the formation of the LED 23 on the circuit board, a silicon rubber is coated upon the surface of the LED 23 such that the light emitting from LED 23 can be incident directly into the light-guiding plate 21. The light incident into the light-guiding plate 21 will be scattered on the top surface of the light-guiding plate 21 uniformly.

As to the prismatic structure 25, it can be formed by a mold injection method such that it can be formed with the light-guiding plate 21 simultaneously. The prismatic structure 25 can concentrate the light emitting from the light-guiding plate 21 to be within a smaller viewing angle, thus enhancing the luminance uniformly.

Fig. 3 is the side view of the enhanced back light structure in Fig. 2. As shown in this figure, the light emitting from the light-guiding plate 21 will be refracted or reflected by the prismatic structure 25 and become more collimated to the front direction. In other word, the light can be confined within a smaller viewing angle to enhance its luminance.

The angle of the prismatic structure 25 placed on the light-guiding plate 21 depends on the desired viewing angle from front direction which should match the viewable angle of the LCD. Generally, the LCD does not have a large viewable angle, which ensure the feasibility of using the prismatic structure 25 to concentrate the light within a smaller viewing angle.

More particularly, the angle θ of the prismatic structure 25 is preferably 60 degree to 130 degree, and 90 degree is most preferable. The depth of the prismatic structure 25 is preferably about 0.025 mm to 0.20 mm, and the width thereof is preferably 0.05mm to 0.30mm.

Figs. 4 and 5 are the perspective views of the second and third embodiment of the enhanced back light structure according to the present utility, respectively. The enhanced back light structure according to the present utility comprises a light-guiding plate 21, a plurality of LED 23 arranged below the light-guiding plate 21, a prismatic structure 25 provided on the top surface of the light-guiding plate 21 to form a prismatic surface.

The prismatic structures in the first, second, and third embodiments have their corrugation extend along the transverse, longitudinal, and diagonal direction, respectively, and all of them can function to direct the emitting light within a smaller viewing angle to enhance luminance.

Figs.6 and 7 are the perspective views of the fourth and fifth embodiment of the enhanced back light structure according to the present utility. The enhanced back light structure according to the present utility comprises a light-guiding plate 21, a plurality of LED 23 arranged below the light-guiding plate 21, a prismatic structure 25 provided on the top surface of the light-guiding plate 21 to form a prismatic surface.

Different from those prismatic structures in the first, second, and third embodiments which extend in one-dimensional direction, the back light structures in the fourth and fifth embodiment have a prismatic structure extending along two-dimensional direction. Therefore, the light traveling within the light-guiding plate 21 can be directed more effectively to the front side.

In other word, in comparison to the prismatic structure with one-dimensional corrugation, the prismatic structure with two-dimensional corrugation has a better ability to guide the emitting light within the viewable angle of LCD.

The enhanced back light structure according to the present utility can increase the luminance uniformly without requiring the LED to have a large quantity and higher grade, and without requiring expensive light-diffusion plate.

The enhanced back light structure according to the present utility provide a prismatic structure with one- or two-dimensional corrugation on the top surface of the light-guiding plate, thus forming a prismatic surface. Moreover, the prismatic structure can be formed by a mold injection process with the light-guiding plate such that the fabrication process can be simplified.

While this utility has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the utility is not limited to the disclosed embodiment and has various modifications.

Therefore, the present utility is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

Claims

1. An enhanced back light structure comprises light-guiding plate, a plurality of LED arranged below the light-guiding plate, a prismatic structure with one-dimensional corrugation provided on the top surface of the light-guiding plate such that the light traveling within the light-guiding plate can be directed and concentrated, through the refraction and reflection of the prismatic structure, to front side.
2. An enhanced back light structure comprises light-guiding plate, a plurality of LED arranged below the light-guiding plate, a prismatic structure with two-dimensional corrugation provided on the top surface of the light-guiding plate such that the light traveling within the light-guiding plate can be directed and concentrated, through the refraction and reflection of the prismatic structure, to front side.
3. An enhanced back light structure comprises light-guiding plate, a plurality of LED arranged beside the light-guiding plate, a prismatic structure with one-dimensional corrugation provided on the top surface of the light-guiding plate such that the light traveling within the light-guiding plate can be directed and concentrated, through the refraction and reflection of the prismatic structure, to front side.
4. An enhanced back light structure comprises light-guiding plate, a plurality of LED arranged beside the light-guiding plate, a prismatic structure with two-dimensional corrugation provided on the top surface of the light-guiding plate such that the light traveling within the light-guiding plate can be directed and concentrated, through the refraction and reflection of the prismatic structure, to front side.
5. An enhanced back light structure substantially as hereinbefore described, and as illustrated in, Figs. 2 and 3; or Fig.4; or Fig. 5; or Fig. 6; or Fig. 7 of the accompanying drawings.

The Patent Office

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Application No: GB 9804131.2
Claims searched: 1-5

Examiner: Andrew Fearnside
Date of search: 16 July 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): G5C (HX)

Int Cl (Ed.6): G02F 1/1335; F21V 8/00

Other: Online: WPI, JAPIO Databases.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0657762 A1	(OIS) See figures 6, 9 & 10.	1
X	EP 0588504 A1	(IBM) See figures 4 & 14.	3, 4
X	EP 0534140 A1	(TOSOH CORP.) See figure 5 & column 7 line 48.	3, 4
X	EP 495273 A1	(LUMITEX INC.) See figure 5 and column 3 line 25.	3, 4
X	US 5627926	(HITACHI) See figures 2 & 8(a).	3, 4
X	US 5600455	(ENPLAS) See figures 4, 10 & 11 and column 1 line 60.	1, 2, 3, 4
X	US 5506929	(CLIO) See figures 7 & 8 and column 16 line 4.	3, 4
X	US 5408388	(STANLEY) See figure 4.	3, 4
X	Patent Abstracts of Japan & J09304605 (Sekisui, 1997).		1, 3
X	Patent Abstracts of Japan & J07151924 (Meitaku, 1995)		2, 4
X	Patent Abstracts of Japan & J07151921 (Meitaku, 1995)		2, 4
X	Patent Abstracts of Japan & J06308485 (Hitachi, 1994)		2

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